MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1 , 2016/2017

ERT3026 - AUTOMATION
(RE)

22 OCTOBER 2016
9:00 am. – 11:00 am.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of **5 pages** including cover page with **5 Questions** only.

2. Attempt **ALL** questions. The distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) A Resistance Temperature Detector (RTD) has α = 0.004/°C at 20°C, R=110 Ω at 20°C, dissipation constant of 25mW/°C and is used in a circuit that puts 8mA through the sensor. If RTD is placed in a bath at 100°C, what resistance will the RTD have? **[12 marks]**

(b) Level sensors are used to determine the amount of product in process tank or containers. Name four reasons to monitor the level of materials in containers. **[8 marks]**

Question 2

(a) Design the interconnections in simple pneumatic system with the following devices by using 24 Volt DC source from PLC controller to control linear motion of double acting cylinder and single acting cylinder.

- Air tube and Air Compressor
- Pressure regulator with gauge
- One Mechanical Valve
- Two Solenoid Valves
- One Push Button Switch
- One Single Acting Cylinder
- One Double Acting Cylinder

[10 marks]

(b) A DC servomotor is used to actuate one of the axes of an *x-y* positioner. The motor has a torque constant of 10 in-lb/A and a voltage constant of 10 V/(1000 rev/min). The armature resistance is 2.0 Ω. At a given moment, the positioner table is not moving and a voltage of 24 V is applied to the motor terminals.

(i) Determine the torque immediately after the voltage is applied and at a rotational speed of 500 rev/min. **[7 marks]**

(ii) What is the maximum theoretical speed of the motor? **[3 marks]**

Continued...

Question 3

(a) Draw a ladder logic diagram for NAND gate. **[4 marks]**

(b) Draw a Programmable Logic Controller (PLC) ladder diagram to control 3 motors starting sequentially with delay as shown in the **Figure Q3(b)**. Start the oil pump motor immediately when START is pressed. The main motor will be started after a 10 sec delay and then the auxiliary motor will be started after a 5 sec delay. In addition, stop all motors immediately when STOP is pressed. The requirements for ladder diagram are given in **Table Q3(b).**

[16 marks]

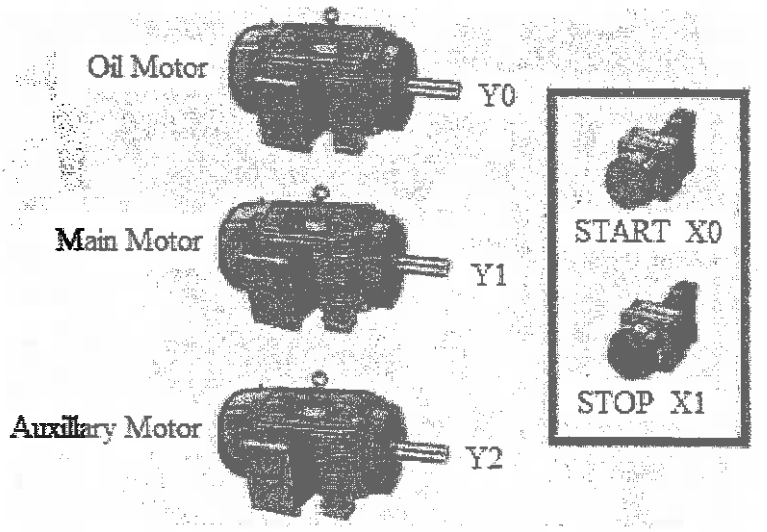

Figure Q3(b). Motors for Question3 (b)

Table Q3(b)- The Requirements for Question 3(b)

	Device	Address
PLC Input	START Push Button Switch (X0)	0.01
	STOP Push Button Switch (X1)	0.02
PLC Output	OIL Pump Motor (Y0)	2.01
	MAIN Motor (Y1)	2.02
	AUXILLARY Motor (Y2)	2.03
PLC Timer	10 seconds Timer, 100 ms Time Base (T01)	T0000
	15 seconds Timer, 100 ms Time Base (T02)	T0001

Continued...

Question 4

(a) A manufacturing system layout, as pictured in Figure Q4 (a), uses a rail guided vehicle system to move parts between stations in the layout. All work parts are loaded into the system at station 1, moved to one of three processing stations (2, 3, or 4), and then brought back to station 1 for unloading. Once loaded onto its Rail Guided Vehicle (RGV), each work part stays on board the vehicle throughout its time in the manufacturing system. Load and unload times at station 1 are each 1.0 min. Processing times at other stations are: 5.0 min at station 2, 7.0 min at station 3, and 9.0 min at station 4. Hourly production of parts through the system is: 7 parts through station 2, 6 parts through station 3, and 5 parts through station 4.

(i) Develop the From-To-chart to show flow rates, loads/hr and travel distance between station and layout. **[10 marks]**

(ii) Develop the network diagram to show material deliveries between load/unload stations. **[5 marks]**

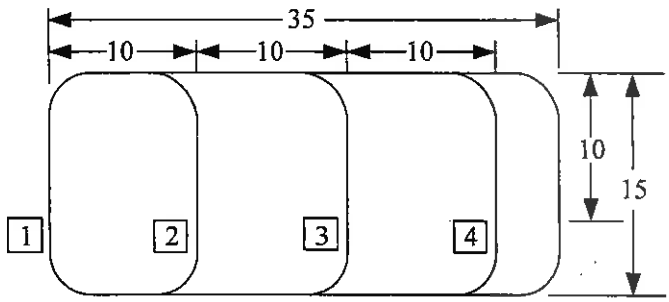

Figure Q4 (a): System Layout for Question 4(a)

(b) A ten-station transfer machine has an ideal cycle time of 30 sec. The frequency of line stops is 0.075 stops per cycle. When a line stop occurs, the average downtime is 4.0 min. Determine average production rate in pc/hr. **[5 marks]**

Continued...

Question 5

A system engineer chose a flexible manufacturing layout that consists of two machining workstations and a load/unload station. The detail of layout is shown in **Table Q5.1**.

All stations are connected by a part handling system that has two work carriers and the mean transport time in the system is 2.5 min. The system produces three products, A, B, and C. The part mix fractions and process routings for the three parts are shown in the **Table Q5.2**.

Determine corresponding production rates of each product.

[20 marks]

Table Q5.1: The Detail of Flexible Manufacturing Layout

Station	Operation	Server
1	Load and unload	2 human workers
2	Drilling operations	4 CNC milling machines
3	Milling operations	4 CNC drilling machines

Table Q5.2: The Part Mix Fractions and Process Routings

Product, j	Product mix, p_j	Operation, k	Station, i	Processing Time, t_{ijk}	Operation Frequency, f_{ijk}
A	0.25	1	1	3 min	1.0
		2	2	20 min	1.0
		3	3	12 min	1.0
		4	1	2 min	1.0
B	0.35	1	1	3 min	1.0
		2	2	15 min	1.0
		3	3	30 min	1.0
		4	1	2 min	1.0
C	0.40	1	1	3 min	1.0
		2	2	14 min	1.0
		3	3	22 min	1.0
		4	1	2 min	1.0

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